IS 12309-1 (1988): Code of Practice for Installation and Maintenance of Aerodrome Lighting Fittings, Part 1: Installation [ETD 24: Illumination Engineering and Luminaries]

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IS : 12309 (Part 1) - 1988

Indian Standard

(Reaffirmed 2003)

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF AERODROME LIGHTING FITTINGS

PART 1 INSTALLATION

UDC 656·71 : 628·971·8·005

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Gr 7

June 1989

Indian Standard

CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF AERODROME LIGHTING FITTINGS

PART 1 INSTALLATION

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards on 29 February 1988, after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Aerodrome lighting fittings are provided as marker lights to give visual guidance to the pilot. These lighting fittings may be elevated type for installation on ground or on suitable support, or inset type for installation in pavement. This code covers good engineering practices for the installation and maintenance of both these types of fittings.

0.3 This code of practice has been prepared in the following two parts:

Part 1 Installation, and

Part 2 Maintenance.

1. SCOPE

1.1 This code of practice covers good engineering practices for installation of aerodrome lighting fittings, of both elevated and inset type.

1.1.1 The installation aspects of associated components like isolating transformers, cables, constant current regulators, control desk, etc, which are part of the aerodrome lighting installation have also been covered in this code.

2. INTERNATIONAL STANDARDS AND RECOMMENDATIONS

2.1 International standards and recommended practices as laid down in the following publications of the International Civil Aviation Organization, shall be adopted in the design of the system and installation of aerodrome lighting equipment:

a) Aerodromes — Annex 14 to the convention on International Civil Aviation Organization.

b) Aerodrome Design Manual — Part 4 Visual aids.

3. EXCHANGE OF INFORMATION

3.1 The first step in the execution of works relating to aerodrome lighting installations is the preparation of the lighting layout plan to suit the operational requirements prescribed by the aviation authorities concerned. This shall be prepared in accordance with the provisions contained in relevant design standard and shall be approved by the civil aviation authorities concerned before actual installation. Such works may also arise while strengthening, widening and/or extension of the existing pavements or while up-gradation of the existing lighting system, calling for information on existing installations. A detailed exchange of information is, therefore, necessary among the planning engineer, the aviation authorities, and the airpot site engineer at this stage.

3.2 Exchange of information between the site engineer and electrical licensee may be necessary both at the time of new installation and while making major additions involving drawal of more power than the installed capacity.

3.3 Where installation of any lighting equipment outside the boundary of the aerodrome is unavoidable, permission of the owner of the land for installation and way leave for maintenance shall be obtained.

4. DISTRIBUTION AND CONTR OL

4.1 The aerodrome lighting installations normally operate on a constant current system, fed from constant current regulator through series circuit cables and isolating transformers. A earth-wire is run over the cabling throughout its run. Remote control of the constant current regulators is effected from a control desk in the air traffic control room through multicore control cable with back indication.

4.2 The series circuits for approach and runway edge lighting (except in low intensity service) are interleaved in at least two circuits, such that in the event of failure of one circuit, the

balanced symmetrical lighting pattern is not affected. Threshold lights should normally be on separate circuits, and for reasons of economy, runway end lights and turning pad lights may be connected to runway edge lighting circuits. A single circuit may be used for taxiways (other than in category III conditions). VASI/PAPI units on the same side of the runway shall be connected in one circuit.

5. CONFORMITY TO SPECIFICATIONS

5.1 The aerodrome lighting fittings shall conform to relevant Indian Standards wherever they exist. The specifications for fittings not covered by Indian Standards and for equipment and materials in aerodrome lighting installation shall be mutually agreed between the purchaser and the supplier.

6. INSTALLATION, MATERIALS AND TOOLS

6.1 Cast Iron Box for Elevated Type Fittings — The CI box over which elevated type aerodrome light fittings are installed shall be made of FG - 200 grade cast iron conforming to IS : 210 - 1978*. The physical dimensions of the CI box shall be suitable for the fitting to be installed and depend also on whether or not an isolating transformer is to be housed inside. The CI box shall have necessary provision for cable entry and earthing. Figure 1 indicates a typical design of CI box.

*Specification for grey iron casting (*third revision*).

6.2 Pipes for Cables

6.2.1 Pipes are used for leading the cables to the fittings from outside the shoulder or across pavements. When laid in shoulder for taking the primary cables to the fittings, the pipe shall be of 80 mm dia galvanized steel, hot finished seamless (HFS) or welded HRIW or HFW screwed and socketed conforming to requirements of IS : 1239 (Part 1)-1973* for medium grade.

6.2.2 Pipes across pavement or directly between fittings in shoulder for the primary cable, shall be 150 mm dia steel pipe/RCC pipe. The RCC pipe shall be non-pressure pipe, Class NP 2.

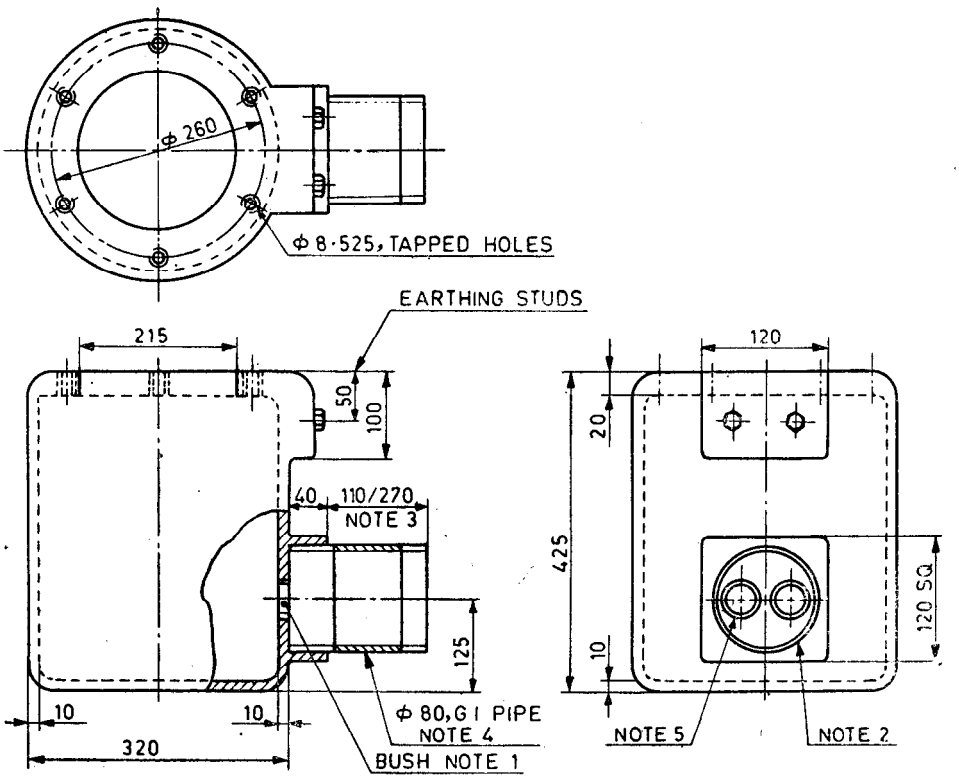
6.3 Sealing Materials

6.3.1 Pipes leading to CI boxes shall be sealed with suitable compound after the cables are drawn to prevent entry of water.

6.3.2 Unused pipes across pavements shall be suitably plugged at both ends to avoid choking.

6.3.3 Where isolating transformers are installed outside the pavement and secondary leads

*Specification for mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fourth revision*).



All dimensions in millimetres.

NOTE 1 — Rubber bush/grommet is to be provided after drawing the cable with connector.

NOTE 2 — Where primary leads are to be taken from the same side of CI box, two holes shall be provided as indicated. Otherwise, a second cable entry provision, same as indicated in figure, shall be provided diametrically opposite to the first cable entry. Both shall be provided with single hole.

NOTE 3 — Dimensions depends on thickness of concrete around CI box.

NOTE 4 — After installation of cable, the pipe mouth shall be sealed with suitable epoxy compound.

NOTE 5 — Hole diameter to suit connector diameter.

FIG. 1 TYPICAL DESIGN OF CI BOX

are taken to the inset fittings by cutting wire ways in the pavement, epoxy type sealant shall be used for refilling the wire ways. Sealant material shall also be used for installation of inset type fittings in pavements. The sealants shall be compatable with the material of the pavement and as recommended by the manufacturer.

6.4 Supports for Approach Lighting Fittings — Approach lighting fittings may be required to be installed on supports due to depressions of land of water-logged situations or obstructions in the approach area. Such supports shall be of any of the following:

a) GI pipe, medium class, 80 mm dia;

b) RCC (1 : 2 : 4) column of at least 225 sq cm sectional area;

c) Lightweight tubular support of aluminium or fibre glass; and

d) Steel tower structure.

The frangibility criteria given in Appendix A shall be complied with.

6.5 Frangible Coupling (Breakable Coupling) — Elevated type aerodrome light fittings shall be installed so as to be frangible and as not to cause danger to aircrafts. They shall, at the same time, withstand blast from jet engine exhaust at 300 knot on runways and at 200 knot within 90 m outside runway ends and in taxi tracks. Arrangment of frangible coupling for the purpose is shown in Fig. 2. The impact load to cause failure of the frangible coupling shall not exceed 5 kgm and a static load to cause failure should not exceed 230 kg applied horizontally 30 cm above the break point of coupling.

6.6 Markers for Isolating Transformers Pits — When isolating transformers are installed directly in ground, suitable markers shall be provided to indicate their location. These may be of GI or aluminium plate on angle iron stake or of RCC.

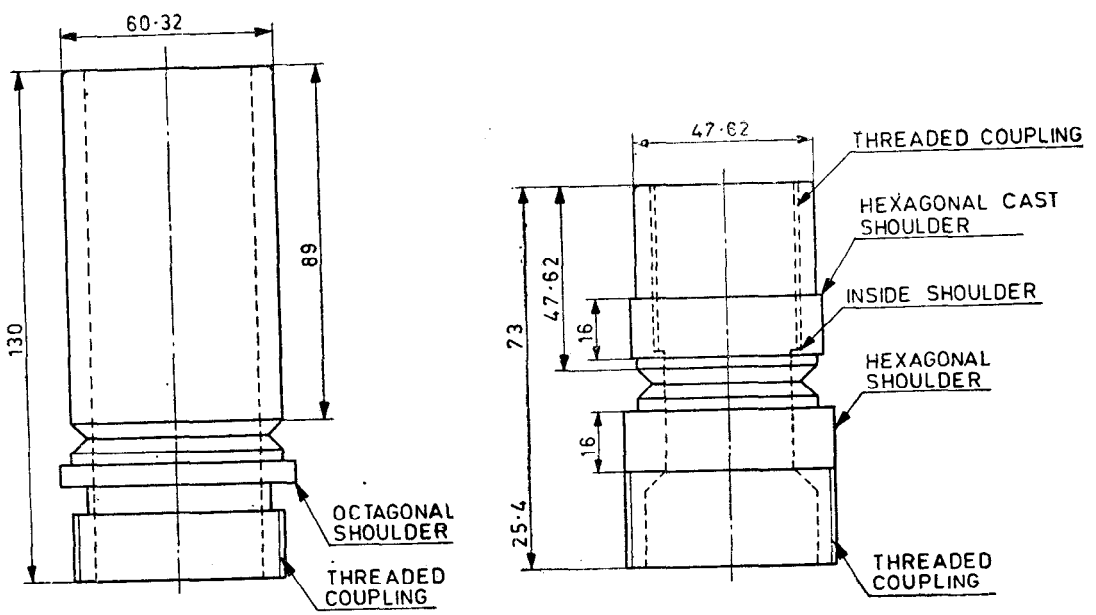
6.7 Tools and Instruments — All tools and instruments for alignment, installation and calibration of the fittings shall be arranged prior to the installation. A recommended list of such tools and instruments is given in Appendix B.

7. INSTALLATION OF ELEVATED TYPE LIGHT FITTING

7.1 Elevated type light fittings are installed in runway, taxiway and apron edges, thresholds, approach area, etc. The installation of elevated type light fitting includes installation of the CI box cement concrete pedestal stake or other supports depending on the location and type of installation proposed, and installation of the fitting itself.

7.2 Installation of CI Box in Soil

7.2.1 CI Box for the fitting is to be installed direct in soil in the absence of a shoulder. Due care shall be taken to ensure its stability in soil. The soil at the sub-base shall be well consolidated, saturating the same with water simultaneously. The CI box shall be installed with 300 mm of 1 : 3 : 6 mix cement concrete at the base and around. During this process, it shall be ensured that the orientation of the CI box will suit the final orientation of the fitting and the pipe connection for cable entry, and body earth connection for counter poise earth wire are made. The top of CI box shall be such that the top of the fitting, when installed, shall not exceed



All dimensions in millimetres.

2a For Runway, Taxiway and Threshold 2b For Approach

FIG. 2 FRANGIBLE COUPLING

350 mm above the level of the edge of the pavement. The concrete shall be trowel finished at the top, sloping outwards and cured by retention of water.

A typical arrangement of the installation is indicated in Fig. 3.

7.3 Installation of CI Box in Shoulder

7.3.1 When the CI box is to be installed in the shoulder, a circular pit is made at the location where the fitting is to be installed. The pit shall be of diameter 300 mm more than the dia of the CI box and of depth 125 mm more than the height of CI box. The pit shall be reammed so as to get a well consolidated sub base. Cement concrete of 1 : 3 : 6 mix shall be poured and consolidated to a depth of 150 mm so that the fitting, when installed over the CI box, may only project above the shoulder by 350 mm.

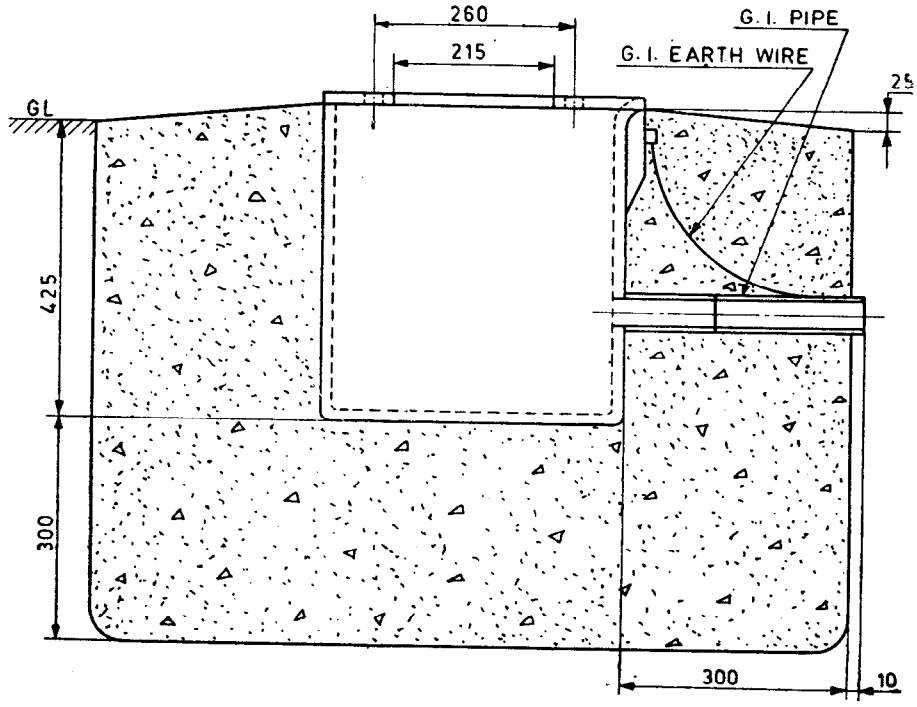
7.3.2 The CI box is placed centrally over the prepared concrete base keeping in view the final orientation of the fitting. Cable entry pipe and the earth wire shall be terminated on the CI box. Cement concrete of the same mix as above shall be filled around CI box and consolidated. The top of the concrete is stopped away from the flange portion of the CI box smoothly. The concrete is cured by retention of water suitably on the finished concrete. The chase cut for the pipe shall be made good to restore the surface to the original finish.

7.4 Installation of Base Mounted Fittings on CI Box — The base mounted fitting shall be installed either over the CI box or on cement concrete pedestal. Where CI box is used, the base of the elevated fitting may be used as cover over the same. This shall be fixed using necessary gasket over the CI box with bolts tightened to the required torque. Where the isolating transformer is to be accommodated inside the CI box, the same shall be installed before the cover is fixed. The hardware portion of the fitting with the breakable coupling shall also be fixed on the base.

7.5 Installation of Base Mounted Fitting on Concrete Pedestal — When the fitting is to be installed over the concrete pedestal, this shall be constructed out of size 450 × 450 × 450 mm using 1 : 3 : 6 CC mix, 50 mm dia GI pipe, in the form of an elbow shall be embedded suitably therein for taking the secondary lead of the isolating transformer to the fitting. The arrangement shall be as shown in Fig. 4 and such that the top of the fitting after installation may not be more than 350 mm above the edge of the pavement. The terminating end of the GI elbow shall be with a screwed coupling, designed for receiving the breakable coupling and also for holding the connection of the secondary lead of the isolating transformer.

7.6 Installation of Stake Mounted Fitting

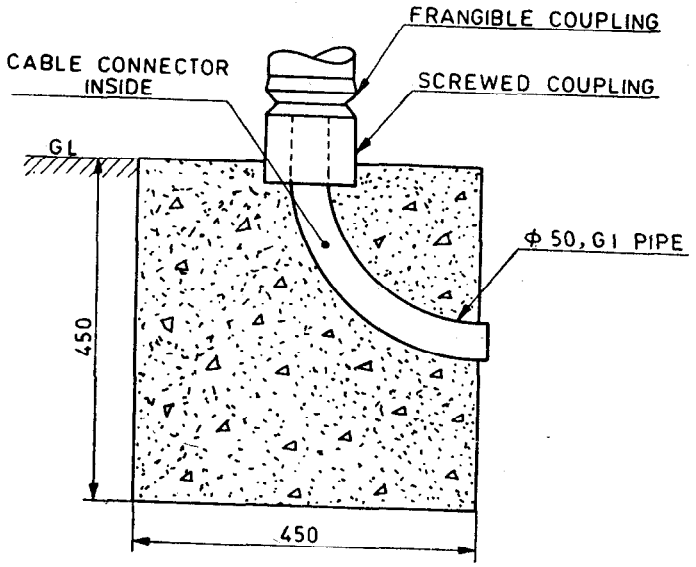
7.6.1 The mounting stake shall be made of 50 × 50 × 6 mm angle iron 0·80 mm long, with a tapped plate welded at one end for receiving the breakable coupling of the fitting. Additionally, a suitable provision shall be made with the



All dimensions in millimetres.

NOTE — GI pipe mouth to be sealed using suitable epoxy compound after drawing cable

FIG. 3 TYPICAL ARRANGEMENT OF INSTALLATION OF CI BOX IN SOIL



All dimensions in millimetres.

NOTE -- Concrete top level to be such that overall fitting height is less than 350 mm above ground level.

FIG. 4 INSTALLATION OF BASEMOUNTED FITTING ON CONCRETE PEDESTAL

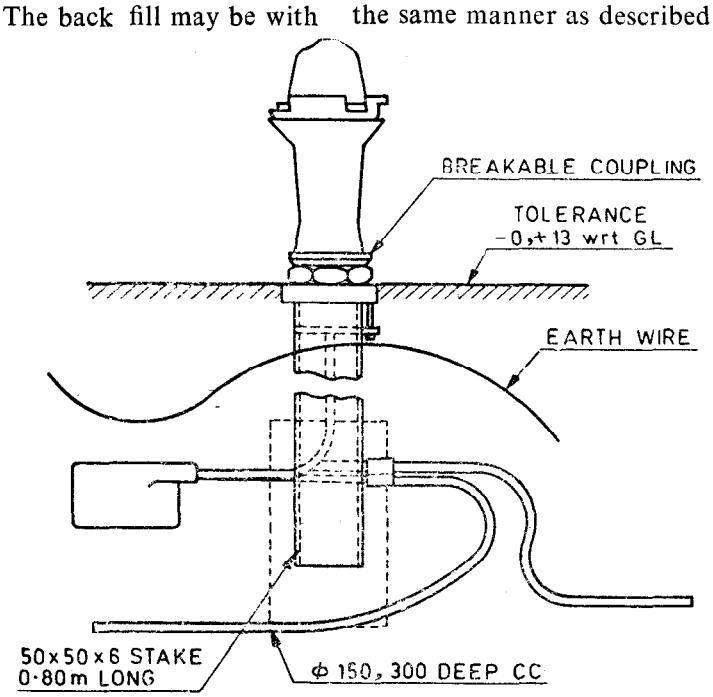
above plate so as to accommodate and hold the connector of the isolating transformer secondary lead near the disconnect point. The design at the top of the stake shall be such that, when assembled with the breakable coupling, the shearing groove shall not be below the top of the stake nor more than 50 mm above the stake.

7.6.2 The stake shall be installed in a 15 cm dia hole and a cement concrete (1 : 3 : 6 mix) anchor, 300 mm deep at the bottom of the stake. The stake shall not be installed by driving. The top of the stake shall be even with the finished ground level but not more than 1·3 cm above the same in any case. The stake shall be within 1° from the vertical. The back fill may be with soil normally and with concrete where soil stability is poor. The fitting with breakable coupling shall be fixed to the stake after making the electrical connection.

7.6.3 The general arrangement of installation is shown in Fig. 5.

7.7 Installation of Elevated Approach Lighting Fitting

7.7.1 The elevated approach light fitting are required to be installed in the over-run of the runway and also beyond. The fittings in the over-run area are intstalled over CI boxes in the same manner as described above.



All dimensions in millimetres.

FIG. 5 INSTALLATION OF STAKE MOUNTED FITTING

In certain cases, barrettes of three fittings with a close spacing may be required to be installed. In such a situation, the isolating transformers for the fittings may be installed either inside the respective CI boxes or could be located collectively in the CI box under the fitting at the centre of the barrette and secondary leads be taken to the other two fittings in CI pipes. The two side fittings may then be installed over a shallow CI box or on a cement concrete pedestal as in **7.5**.

7.7.2 The fittings outside the over-run may be required to be installed on pipe supports or towers, depending on the height. For detailed guidance on the height at which the fittings should be located above the ground level depending on the gradient of the terrain as per relevant design standard.

7.7.3 The pipe supports shall be installed over cement concrete (1 : 3 : 6 mix) anchor of 300 mm × 300 mm size, the depth being 1/5 of the support length. The minimum depth shall, however, be 800 mm. The frangible coupling shall be provided just above the ground level. The fitting shall be installed on top of the GI pipe using suitable clamps of galvanized steel strip. Provision shall be made for clamping the cable connection to the fitting on the pipe support.

7.7.4 Where the approach light fitting is required to be installed at a considerable height above ground level calling for provision of tower structure, the frangibility criteria, as indicated in Appendix A, shall be satisfied so that, if this is hit by an under shooting aircraft, this may collapse without causing damage to the aircraft. Means shall be provided for maintenance of the fitting and lamp replacement, and for leading the cable to the fitting.

8. INSTALLATION OF INSET TYPE FITTINGS

8.1 Inset fittings are intended for use in poor visibility conditions to give output in precise envelopes, and in the case of displaced thresholds, for maintaining the pattern of approach lighting system. The installation tolerances permissible are, therefore, very small. The light beam shall be aligned parallel to the centre line of the runway within ±1/2 degree. The fitting must be level and its edge must be between +0, −2 mm from the top of the pavement. The installation has to be, therefore, carried out with precision. Tools jigs and other installation accessories, as per recommendations of the manufacturer, shall be used. The installation procedure prescribed by the manufacturer shall be strictly adopted. Provisions contained hereunder shall be taken to supplement the same.

8.2 Inset fittings may be required to be installed either in an existing pavement (rigid or flexible) or on a existing pavement with flexible overlay or in a totally new pavement (rigid or flexible).

8.3 Installation in Existing Pavement (Rigid or Flexible)

8.3.1 The fitting with a shallow base is used. The base is installed in the pavement and the top assembly is installed over the same.

8.3.2 After precisely marking the location for installation of the fitting, a hole is drilled in the pavement to the required diameter and depth using a core drilling machine. Normally a clearance of about 6 mm should be available around the base and also between the base and the pavement for the sealant materials. It is advantageous to use two narrow cutters instead of a single wide cutter for drilling in flexible pavements to avoid gumming up of melting asphalt while drilling.

8.3.3 The wireways for taking the secondary leads in flexible pavements should also be cut, preferably using a double blade cutter.

8.3.4 Where wet sawing is adopted, the wire ways shall be flushed with high velocity stream of water immediately after sawing. The wire ways shall be fully dried up.

8.3.5 The depth of saw kerf (wire way) should be 25 mm, and the width 9 mm minimum to install 2 wires, one above the other. These dimensions may be increased to accommodate additional wires, where necessary.

8.3.6 Where the wire way is to cross existing joint seal in rigid pavements, the wire way may be made deeper near such joints so that the secondary leads are at not less than 12 mm below the joint seal compound.

8.3.7 The light fittings shall not be handled by the leads.

8.3.8 The external surface of the fitting base as well as the drilled hole/wire way in the pavement shall be absolutely clean and dry. Sand blasting of the base immediately prior to installation is recommended.

8.3.9 The type of sealant material is usually paste type below the base and liquid type for the sides. Due care shall be taken while placing the sealants so as to ensure that there are no entrapped air pockets.

8.3.10 The installation jigs may be removed, only after the sealant has set. Manufacturer's instructions in respect of time for setting shall be adopted.

8.3.11 The secondary leads shall be placed in the wire ways at least 12 mm below the pavement surface, and held in position by suitable clips/ wedges. Wood shall not be accepted as a wedge material. No intermediate joints are permitted in the run of the secondary leads. Even the splicing for connection to the fittings should be staggered.

8.3.12 Where recommended by the manufacturer, clear sand to the recommended fineness may be added to the liquid sealant in wire ways, till a slight amount of sand shows on the surface.

8.3.13 The sealant material shall not be poured in excess so as to extend above the pavement surface.

8.3.14 In the case of flexible pavement, it is preferable to provide junction boxes near the fittings, considering the likely future overlays. Similar provision of junction boxes may be advantageous where more than one fitting, such as in touch down zone, are to be installed.

8.3.15 The top assembly of the fitting is fitted over the base with a gasket and bolts are tightened to recommended extent using a torque spanner.

8.4 Installation in New Pavements

8.4.1 The method outlined in **8.3** could be adopted in new pavements but this is not considered economical and the method given hereunder is recommended.

8.4.2 The top assembly of the light fittings in new pavement constructions are installed over a deep base. The base may be in one piece or two depending on whether the pavement is laid in one layer or two.

8.4.3 The installation procedure involves installation of the base in cement concrete anchor suitably, prior to the laying of pavement concrete (bitumenous/cement). In new pavement constructions, the locations for installation of these bases have, therefore, to be carefully determined as they may have to be set 'in space' due to lack of references very precisely. Suitably designed rigid jigs shall be procured from the manufacturer and used in correctly positioning the base so that the fitting, when installed after completion of the construction of the pavement, may not project above the finished pavement beyond permissible level, nor remain too much below the pavement surface. The jig shall establish the elevation and azimuth of the base.

8.4.4 The excavation in soil or sub-base and soil, as the case may be, shall be done at the precise location. The base and a reinforcement steel cage shall be held in place with the jig, and these shall not be disturbed while placing the cement concrete for anchor. The jig shall be retained in position till the cement concrete has set.

8.4.5 The connection between the cable entry pipe and the base shall be done before placing the anchor concrete. Liquid tight flexible pipe is recommended for the purpose as this will allow adjustments in the light base alignment before concrete anchor is placed.

8.4.6 The fitting base shall be suitably protected using steel cover plate, when the pavement is laid.

8.4.7 The surface of the pavement around the light base shall be levelled with the surrounding pavement, without any dished or mound areas.

8.4.8 In every case, care shall be taken to check the level of the top flange of the light base with reference to finished pavement so that there is no undue projection of the fitting, when installed over the same. Where necessary, suitable spacer/adoptor rings shall be used to raise the fixture to proper elevation.

8.4.9 In the case of flexible pavements, the fittings base shall be of two sections. The bottom section is first installed in concrete anchor such that the top of the same does not protrude above the sub-base.

The upper section of the light base is installed when the top asphaltic surface is laid.

8.4.10 Where the pavement (rigid or flexible) is laid in stages, the light base should also be sectionalized accordingly and individual sections be installed before every 'pass' of the paving machine. The two sections of the base are jointed using a suitable sealant material. The sections are suitably protected using steel cover plate during paving operations.

8.4.11 Water tight gasket supplied by the fitting manufacturer shall be provided between the base and top assembly of the fitting. Holding bolts shall be tightened to the recommended extent using torque spanner.

8.5 Installation in Pavements to be Overlaid

8.5.1 The procedure as in **8.4** for installation in new pavements is applicable in this case also except that the bottom section of the light base and the cable pipe are provided in the openings to be made in the existing pavement. The provision of concrete anchor and use of flexible pipe connectors are necessary in such installations.

8.5.2 Extension rings of paper dimensions shall be used, depending upon the thickness of overlay to be added.

9. INSTALLATION OF VASIS

9.1 General

9.1.1 The VASIS is intended to provide a precise approach slope guidance to the landing pilot. The layout of the VASIS shall be as per provisions contained in the relevant design standards. Some salient aspects, as essential for installation, are outlined hereunder.

9.1.2 The approach slope angle indicated by VASIS shall not be different from that provided by the non-visual aids of the runway. This shall be coordinated before deciding the setting angles of the VASIS light units.

9.1.3 The distance of the downwind wing bar from threshold determines the aircraft wheel clearance above the threshold and thus the lower limit of the safe approach corridor. Undue increase of this clearance shifts touch down the zone unnecessarily. Where the approach slope

is less than 3, the standard distance of 150 m should be increased by 5 m for every 5 minutes of arc that the angle is less than 3°. Also, for every 0·3 m by which threshold is higher than the level of runway centre line at 150 m from threshold, the standard distance should be increased by 6 m.

9.1.4 The longitudinal spacing between wing bars determines the sensitivity of the system and fixes the depth of safe approach corridor. Excessive distance between wing bars though may improve discrimination between them at ranges even greater than 8-10 km will result in loss of sensitivity in approach guidance which falls considerably since the depth of approach corridor becomes unduly large. Too much reduction of this spacing has the opposite effect, namely, lack of discrimination between wing bars and unacceptably low depth of approach corridor.

9.1.5 It is recommended that in the case of 2 bar VASIS, the lateral spacings of the VASI units should be calculated such that, when viewed from correct slope angle of approach, the wing bars have a 'square' appearance. For any increase or decrease of distance between wing bars from normal value of 210 m, the width of the wing bars should be correspondingly increased or decreased at the rate of 1·5 m for every 30 m shift for 3° approach slope angle.

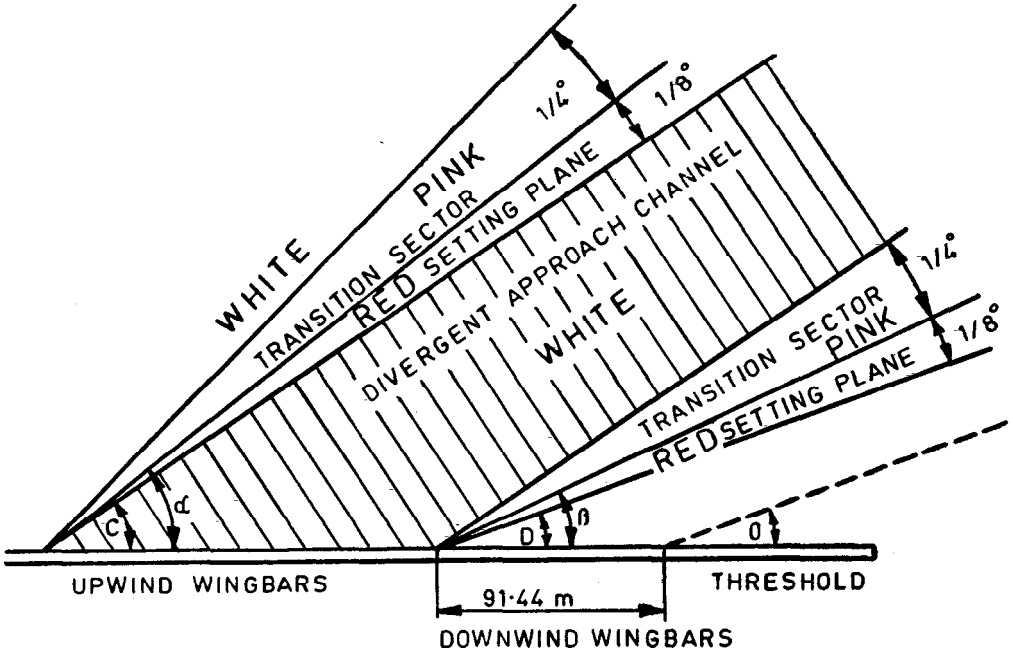
9.1.6 There may be falling or rising gradients of ground from the runway edge. Where possible, these should be met by adjusting the heights of supports. However, maximum height of the VASI unit above ground shall not exceed 500 mm. Alternatively, the unit may be shifted towards or away from threshold depending on the ground level at the desired location of the light unit being higher or lower respectively then the level of the runway. The extent of such shift shall be accurately calculated so that, after installation, the light would appear to come from the ideal location, namely, in line with the other units in the same wing bar.

9.1.7 The angular settings of the VASI units are calculated so as to provide the desired approach slope angle and a reasonable depth of approach corridor. The wheel clearance above threshold for the landing aircraft is determined by the setting of down wind units.

The 'setting angle' of the VASI light unit is the angle at which the unit is physically set at site. Practically this is the angle at which a thin line of white light appears above the lower edge of the front aperture of VASI light unit when viewed from a distance of about 30 m. The pilot of an approaching aircraft would recognize the light from the unit as changing from pink to red at an angle 1/8° above this setting angle. The pink transition section of the light beam is 1/4° wide (*see* Fig. 6).

When flying on correct approach slope, the down wind units would be seen as white and hence the top of their pink sector defines the lower edge of the approach corridor considering undershoots. Similarly, as the upwind units would be seen as white on correct slope, bottom of their pink section defines the upper edge of the approach corridor, considering overshoots. The approach slope angle is the mean of the angles of top of pink sector of downwind units and bottom of pink sector upwind units.

The VASI units should be set so as to provide a reasonable depth of approach corridor to the



Approach Slope Angle = $\frac{\alpha+\beta}{2}$

FIG. 6 VASIS LIGHT BEAMS

landing pilot. This depth will also increase or decrease corresponding to the distance between the wing bars and, in order to maintain the depth of approach corridor to a reasonable extent, the difference in setting angles of upwind and downwind units may have to be narrowed or widened accordingly. Table 1 indicates typical setting angles for different approach slope angles and different distances between wing bars.

TABLE 1 TYPICAL SETTING ANGLES FOR VASI LIGHT UNITS

Nominal Approach Slope Angle		Distance Between Upwind and Downwind Wing Bars		
		Less Than 180 m	180 to 260 m	More Than 260 m
(1)		(2)	(3)	(4)
	U	2°35′	2°30′	2°25′
2°30′	*D*	1°55′	2°00′	2°05′
	O	1°05′	1°10′	1°15′
	U	2°50′	2°45′	2°40′
2°45′	*D*	2°10′	2°15′	2°20′
	O	1°20′	1°25′	1°30′
	U	3°05′	3°00′	2°55′
3°00′	*D*	2°25′	2°30′	2°35′
	O	1°35′	1°40′	1°45′
	U	3°20′	3°15′	3°10′
3°15′	*D*	2°40′	2°45′	2°50′
	O	1°50′	1°55′	2°00′

U = Elevation setting angle of units forming upwind wing bars.

D = Elevation setting angle of units forming downwind wing bars.

O = Elevation of obstacle clearance plane.

9.1.8 In the case of 3 bar VASIS, the setting angle of downwind wing bar units is determined from the point of view of wheel clearance above threshold for aircrafts whose wheel-to-eye height is more than 4·5 m as in **9.1.7**.

The middle wing bar is set on the same considerations for upwind and wing bar of 2 bar VASIS. Additionally, wheel clearance above threshold for aircrafts whose wheel-to-eye height is more than 4·5 m should be checked for the type of aircraft expected to use the system, that is, the lowest angle at which light from middle wing bar changes from red to white should be checked. The upwind wing bar is set as in the case of 2 bar VASIS, but in relation to the middle wing bar.

The inter-relationship between angles in 3 bar VASIS is such that the difference between the downwind approach slope angle and the upwind approach slope angle can never be less than the depth of transition sector of the middle wing bar light units (*see* Fig. 7). It is desireable that the upwind and downwind approach slopes be as close to parallel as possible. Approach slope angle of 3° is normally not exceeded, especially for large bodied aircrafts and this fixes the upper limit on the upwind approach slope angle. At the same time, considerations of obstacle clearance may necessitate the downwind approach slope angle being much lower than 3°.

Thus the elevation settings in a 3 bar VASIS is quite criminal and the VASI light units should have a sharp transition, not more than 15 minutes of arc. This will ensure reasonable depths of approach corridors for both large and small aircrafts without convergency of the light beams.

9.2 Installation Tolerance — The permissible tolerances in installation of VASI light units are as under:

a) The front face of the units shall lie in a plane perpendicular to the runway centre

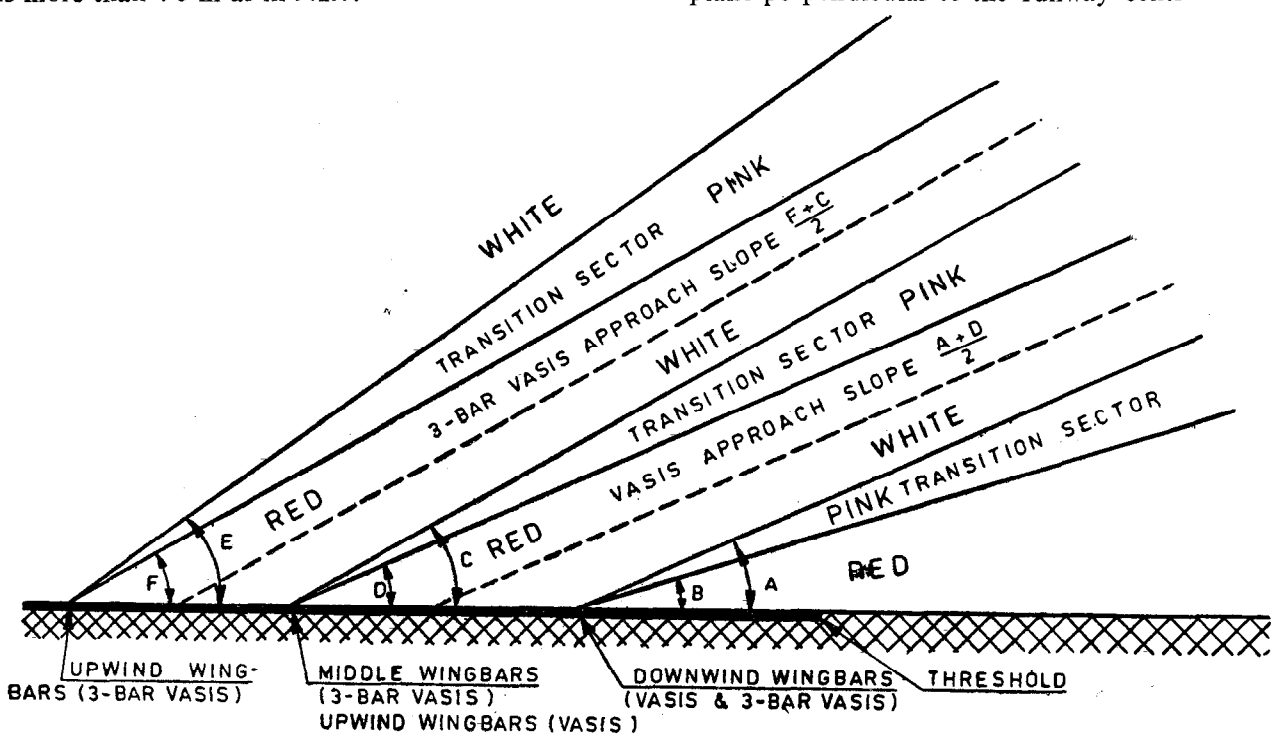


FIG. 7 LIGHT BEAMS AND ANGLE OF ELEVATION SETTING OF 3-BAR VASIS AND 3-BAR A VASIS (AS SEEN IN SPACE)

line within 1°.

b) The front aperture of the units shall be horizontal within 1/4° and at the same level within 5 cm as adjacent units in the wing bar.

c) The lower edge of the front aperture of the units shall be within 30 cm of the level of the nearest point on the centre line of the runway.

d) The line of one wing bar formed by the front faces of the light units shall be within 3 m longitudinally of the line of wing bar on the opposite side of the runway. Where shoulder gradients are encountered necessitating physical shift of the light units, such longitudinal separation shall not exceed 30 m.

e) The inner most unit shall be located not closer than 15 m and not farther by 23 m from the runway edge. Minimum clearance from taxiways shall be according to Table 2.

f) Light units forming each pair of wing bars shall have the same setting angle within +2 minutes of arc.

9.3 Essential Aspects in the Installation of VASIS

9.3.1 In order to ensure a fully satisfactory installation, the site engineer should study the sitting details of the light units, examine/compare with the actual site conditions so that all aspects outlined above can be satisfied. The setting angles for individual wing bar units and the length of supports for individual units shall be calculated and got approved with the layout from the concerned aviation authorities.

TABLE 2 TAXIWAY MINIMUM CLEARANCES

[*Clause* 9.2 (e)]

Code of Letter of Longest Runway Served	Distance Between Any Point on the Edge of a Taxiway and the Edge of a Runway		Distance Between any Point on the Edge of a Taxiway and Edge of Another Taxiway	Distance Between any Point on the Edge of a Taxiway and a Fixed Object
	Instrument Run way	Other Runway		
	(m)	(m)	(m)	(m)
(1)	(2)	(3)	(4)	(5)
A	150	75	62	38
B	150	73	52	30
C	150	73	43	26
D	—	36	27	18
E	—	29	23	16

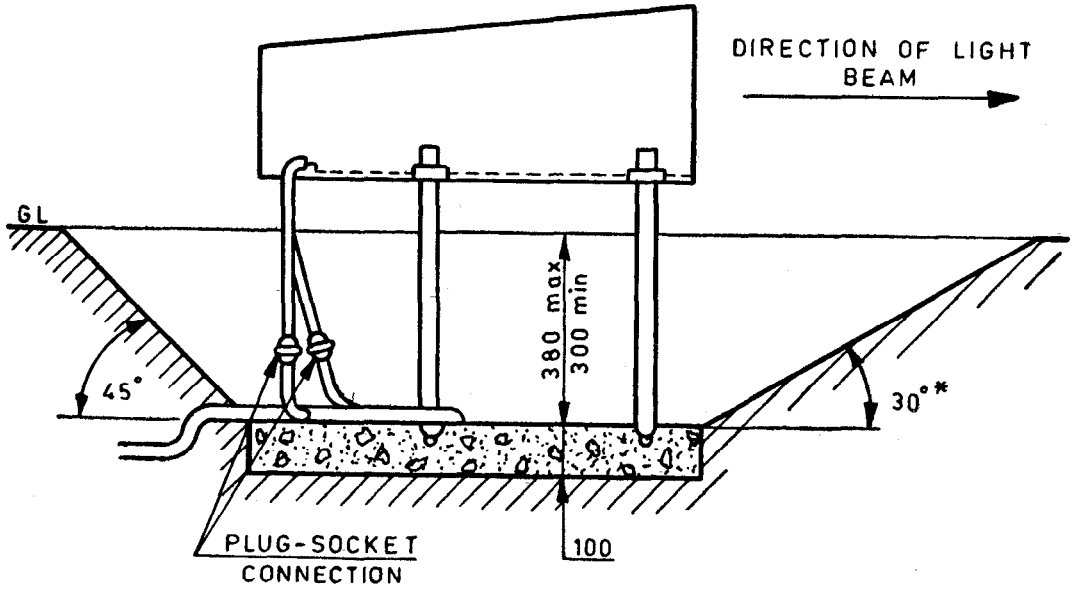
NOTE 1 — The clearances specified on columns 4 and 5 for runway code letter *A* based on providing a 15 m clearance for an aeroplane with a 60 m wing span, and a distance between the outer main wheels of 13·5 m and when the aeroplane is located such that the outer main wheels are at the edge of the taxiway.

NOTE 2 — The clearances specified in this table do not apply to an aircraft taxing on an apron.

9.3.2 Manufacturer's instructions shall be followed for the installation procedure. The provisions contained hereunder should supplement the same.

9.3.3 The light units shall be handled with care so that they do not undergo any deformation in transit

9.3.4 Each unit is mounted on a cement concrete base using support pipes. In order that the concrete block does not form an obstruction to an aircraft inadvertently running into the soil, the concrete base is sunk so that its top surface is at 30 to 38 cm below ground level (*see* Fig. 8).



All dimensions in millimetres.

*30° in front and not greater than 45° on any side.

FIG. 8 INSTALLATION OF VASI LIGHT UNIT

9.3.5 Pockets for grouting the support pipes shall be left while making the base.

9.3.6 A positioning jig, which is basically base frame of VASI unit, should be used aligning the unit axis parallel to the runway centre line and for grouting the support pipes, to avoid disturbance to the light units during installation. This shall be removed only after the grout has set.

9.3.7 Adjustments in height of the units to the specified height above datum is made through the nuts on the supports pipes. Sighting device shall be used in correctly aligning the unit in azimuth.

9.3.8 The lamps shall be individually adjusted for a maximum amount of light through the front aperture. A lamp setting bench shall be used for the purpose.

9.3.9 The cavity above the sunken base shall be filled with stone chippings up to ground level or 5 cm below the light unit base, whichever is less.

9.3.10 The units shall be adjusted according to the procedure given by the manufacturer, for setting the elevation angles individually. Accurate spirit level, clinometer and allen keys should be used for setting the angles.

9.3.11 The installation shall be flight checked so:

a) that the appearance of the light units forming each pair of wing bars is not uneven and that they change colour simultaneously and appear to be substantially in a horizontal line.

b) that the depth of the transition sector of the light units appears to meet the requirements of relevant design standards.

c) that the effective range of the light units appears to meet the design requirements of design standards and the extent to which they appear to comply with the requirements of relevant design standards should be ascertained.

d) that the intensities of individual light units are the same and that the intensity control provided is satisfactory for day and night operations.

e) that the approach slope indicated by the light units is operationally satisfactory and where a non-visual glide path is also provided, the visual and non-visual indications are compatible.

f) that no other lights on the aerodrome interfere with a clear interpretation of the signals from the light units.

g) that the elevation setting of the downwind bars ensures a safe clearance over all obstacles in the approach as required by the design standards.

9.3.12 In order to enable checking the units from ground periodically, a checking plinth is constructed at 30 m from each light unit. A sighting stick (or checking stick) is calibrated for each unit, immediately after satisfactory flight check.

9.3.13 The units shall be checked from ground using the calibrated sighting stick every day till the stability of the system is assured.

10. INSTALLATION OF PAPI — (to be added later)

11. INSTALLATION OF ISOLATING TRANSFORMERS

11.1 The current practice is to use neoprene moulded, epoxy encapsulated isolating transformers. These may be placed inside the CI boxes or installed direct in the ground.

11.2 Where installed directly, in ground, these shall be located at least 450 mm below ground level, and with a 100 mm layer of sand both below and above them. Suitable mechanical protection and location makers shall be provided.

11.3 After making connections to the series cables and fittings, the connector joints are protected by 4 or 5 overlapping layers of insulation tape.

12. INSTALLATION OF CONSTANT CURRENT REGULATORS (CCR)

12.1 CCRs shall be first examined for any damages/disturbances in transit. Packing materials, if any, provided inside for transporation shall be removed.

12.2 Cement concrete plinths of the required size shall be constructed to mount the units.

12.3 The units shall be installed such that there is at least 1 m space around for proper ventilation and inspection.

12.4 The internal wiring terminations as well as external connections (both power and control) shall be checked so that they are absolutely tight.

12.5 The body of each CCR shall be connected to the earth system by double earth conductors.

13. INSTALLATION OF CABLES

13.1 As the airport lighting series cables are high voltage cables should be handled with care as necessary for HV cables. The method of laying shall be same as outlined in the relevant Indian Standards. A lower depth up to 0·8 metres below ground level within operational areas is acceptable since approach to the area is restricted.

13.2 Due consideration should be given for the likely widening of pavements, and also the likely provision of shoulders on a future date. This will avoid dismantling of the cable system when the future pavements for extension/shoulders are laid.

13.3 Cables feeding approach light fitting on tower pipes shall be suitably clamped at a normal spacing of one metre. Care shall also be taken to ensure that there is no possibility of rain water entering the fitting through the cables.

13.4 The cables are sometimes jointed at site for terminating to the connector kits. Crimping joints are recommended. Special care shall be taken to ensure that there is no possibility of water entry through the space between cable and the connector.

13.5 Sufficient loop length shall be left opposite to each fitting.

14. INSTALLATION OF CONTROL DESK

14.1 The control desk shall be located in consultation with the aviation authorities suitably so that the desk is conveniently accessible to the operator, and at the same time it is easy to maintain.

14.2 It is recommended that the multicore control cable is terminated on a terminal block with core identification ferrules before connecting to the circuits in control desk.

APPENDIX A

(*Clauses* 6.4 *and* 7.7.4)

FRANGIBILITY CRITERIA FOR VISUAL AIDS

A-1. ELEVATED LIGHT FITTINGS FOR RUNWAY, TAXIWAY, THRESHOLD END AND STOPWAY

a) The maximum permissible height above the pavement level is 36 cm.

b) These aids should be mounted on frangible mounting devices. The impact load required to cause failure at the break point should not exceed 5 kg and a static load required to cause failure should not exceed 230 kg applied horizontally 30 cm above the break point of the mounting device. The desirable maximum height of light units and frangibles coupling is 350 mm above ground. Units exceeding this height limitation may require higher breaking characteristics for the frangible mounting device, but the frangibility should be such that, should a unit be hit by an aircraft, the impact would result in minimum damage to the aircraft.

c) Fittings for runways of up to 1 200 m and used by jet aircrafts shall withstand an exhaust blast at 300 knots and for other runways as well as all taxiways they shall stand a blast at 200 knots.

A-2. APPROACH LIGHTING SYSTEM

a) Fittings up to 90 m from runway end shall withstand a blast of 200 knots and beyond this distance a blast of 100 knots or the national environmental wind load.

b) Supports shall beg a frangible design or have a frangible device.

c) Where the terrain requires light fittings and their supporting structure to be taller than approximately 1·8 m and constitute the critical hazard, it is considered that it is not practicable to require that the frangible mounting device be at the base of the structure. The frangible portion may be limited to the top 1·8 m of the structure except if the structure itself is frangible. Though there is need to provide frangibility for approach lights installed beyond 300m before the threshold (as these lights are required to be below the approach surface), it is recognized that protection needs to be provided for aircraft that might descent below the approach or take-off surfaces. A frangible top portion of 1·8 m is considered to be a minimum specification and a longer frangible top portion should be provided, where posssible.

d) In all cases, the unit and supports of the approach lighting system should fail when an impact load of not more than 5 kg and a static load of not less than 230 kg is applied horizontally at 30 cm above the break point of the structure.

e) Where it is necessary for approach lights to be installed in stopways, the lights should be inset in the surface when the stopway is paved or when the stopway is not paved either inset or, when the lights are elevated, meet the criteria for frangibility agreed for lights installed beyond the runway end.

A-3. OTHER VISUAL AIDS

a) These aids should be located as far as is practicable, from the edges of runways, taxiways and aprons, as is compatible with their function. Every effect should be made to ensure that the aids will retain their structural integrity when subjected to the most severe environmental conditions. However, when subjected to aircraft impact in excess of the foregoing conditions, the aids will break or distort in a manner which will cause minimum or no damage to the aircraft.

b) Caution should be taken when installing visual aids in the movement area to ensure the light support base does not protrude above ground but rather terminates below ground as required by environmental conditions so as to cause minimum or no damage to the aircraft over-running them. However, the frangible coupling should always be above ground level.

APPENDIX B

(*Clause* 6.7)

LIST OF RECOMMENDED TOOLS AND INSTRUMENTS FOR INSTALLATION

B-1. FOR ALL FITTINGS

a) Theodolite

b) Spirit level

c) Plumb line

d) Box wrench

B-2. FOR VASI INSTALLATIONS

a) Clinometer

b) Precision levelling bar

c) Two allen wrenches

d) Box spanner for lamp setting bench, etc

e) Adjustable wrench

f) Positioning jig

g) Sighting device

h) Lamp setting bench

j) Checking stick

B-3. FOR INSET FITTINGS

a) Prism setting tool

b) Lighting handle/hook

c) Reflector alignment tool

d) Pressure testing fitting

e) Levelling tool

f) Lamp extractor

g) Installation and alignment tool/device

h) Installation fixture/key for fastening inset fitting

j) Torque spanner

k) Peeling pliers

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Printed at Swatantra Bharat Press, Delhi (India)